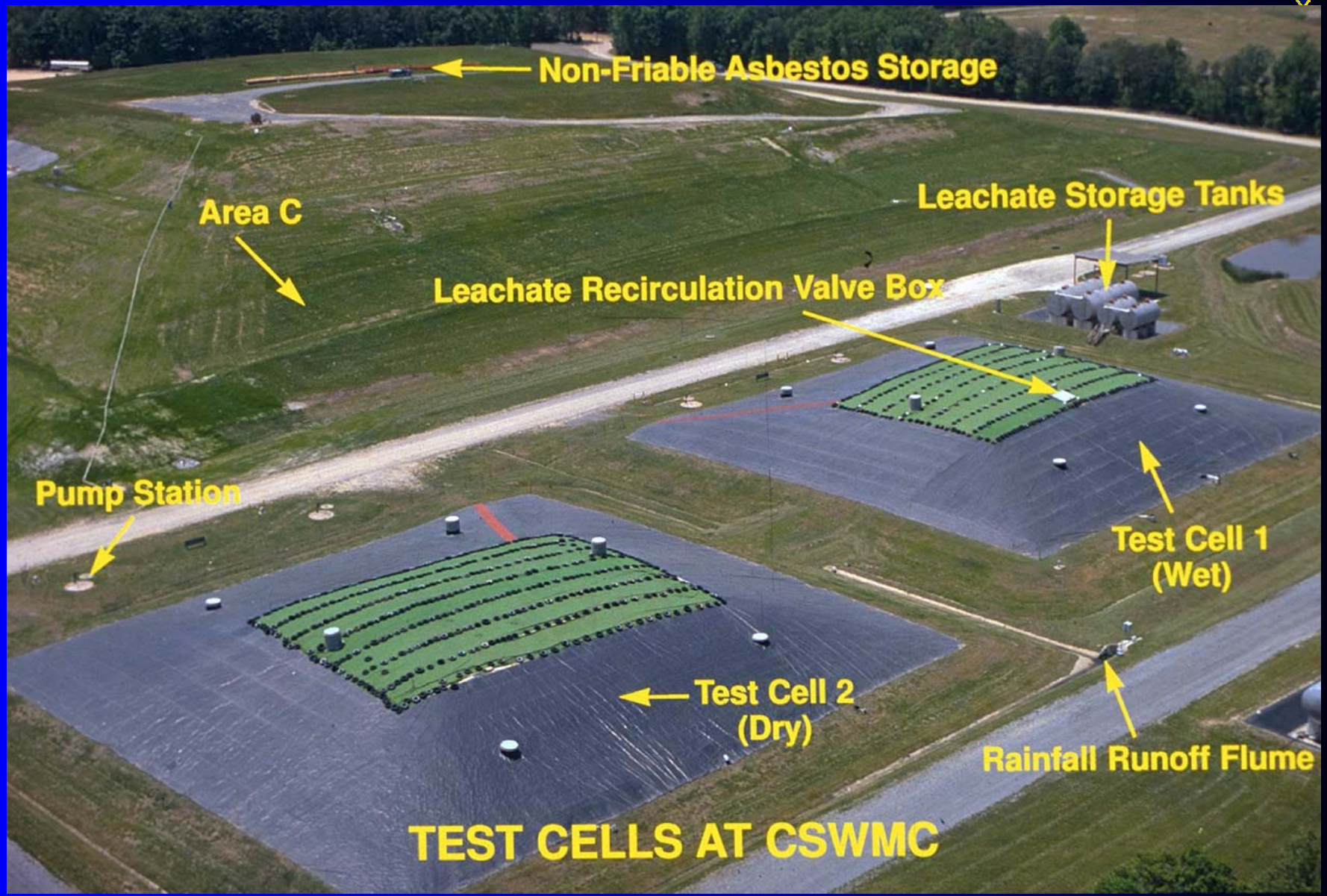
Bioreactors – Practical Experience

By Anne M. Germain, P.E. DEE


Non-Friable Asbestos Storage
Area C
Leachate Storage Tanks
Leachate Recirculation Valve Box
Pump Station
Test Cell 1
(Wet)
Test Cell 2
(Dry)
Rainfall Runoff Flume
TEST CELLS AT CSWMC

Material Placed in Time Capsules - 1990


AQUA NET
Tide
Tide
TIDE'S IN...DIRT'S OUT
'90 3 20


WONDER
AJAX
'90 3 20


'90 3 20


'90 3 20

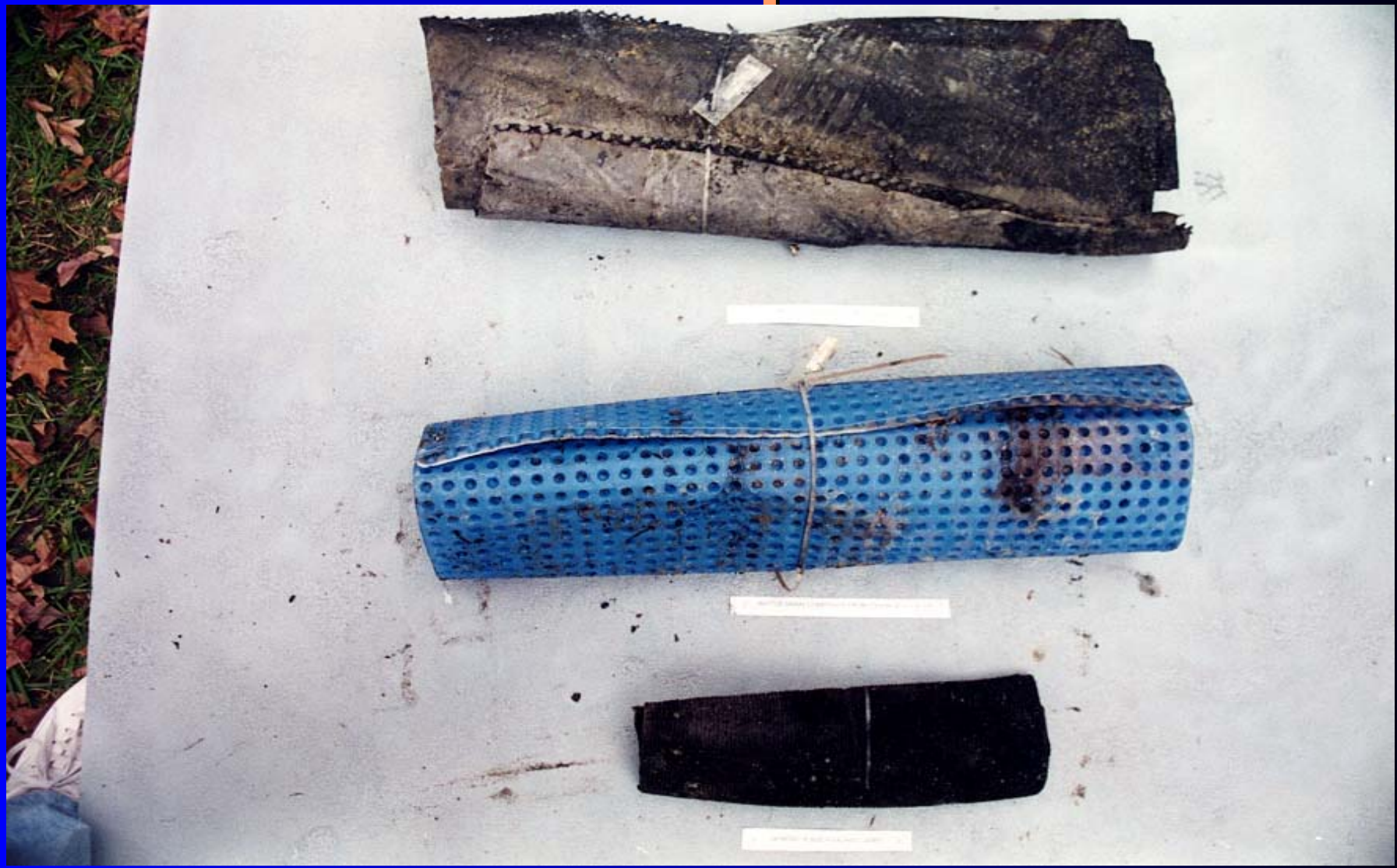

State News
McCartney: 3 Beatles may come together
Holiday goodies
The News Journal
THE WALL STREET JOURNAL.
What's News
TIME
CONGRESS:
Senate Majority Leader Robert Byrd
Waste Age
Pass the Trash
'90 3 20


BURGER KING
WHOPPER
BURGER KING
'90 3 20

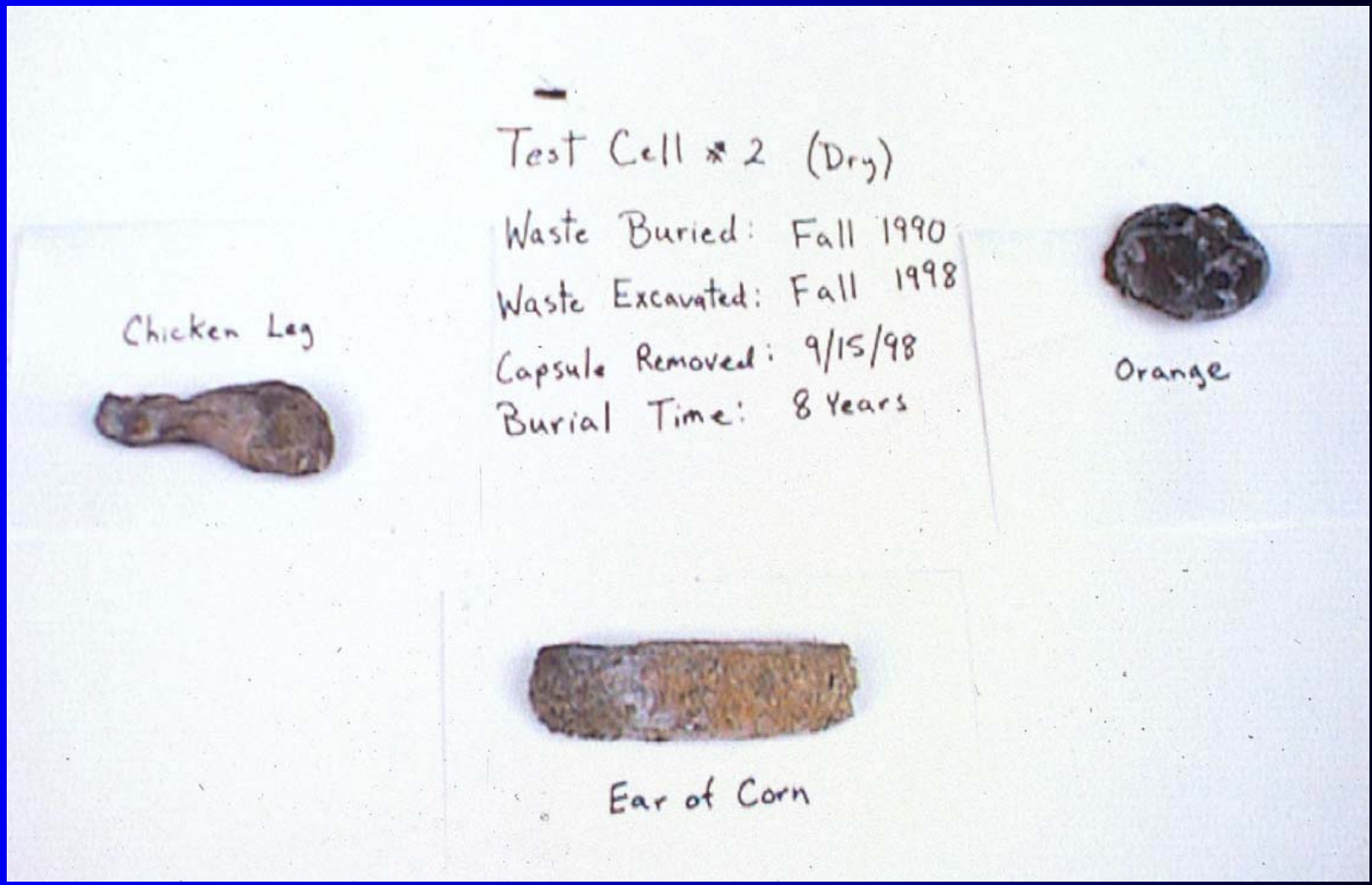
Trommeling Test Cell Waste

Excavated Waste from bioreactor test cell

Material retrieved from test cell time capsule

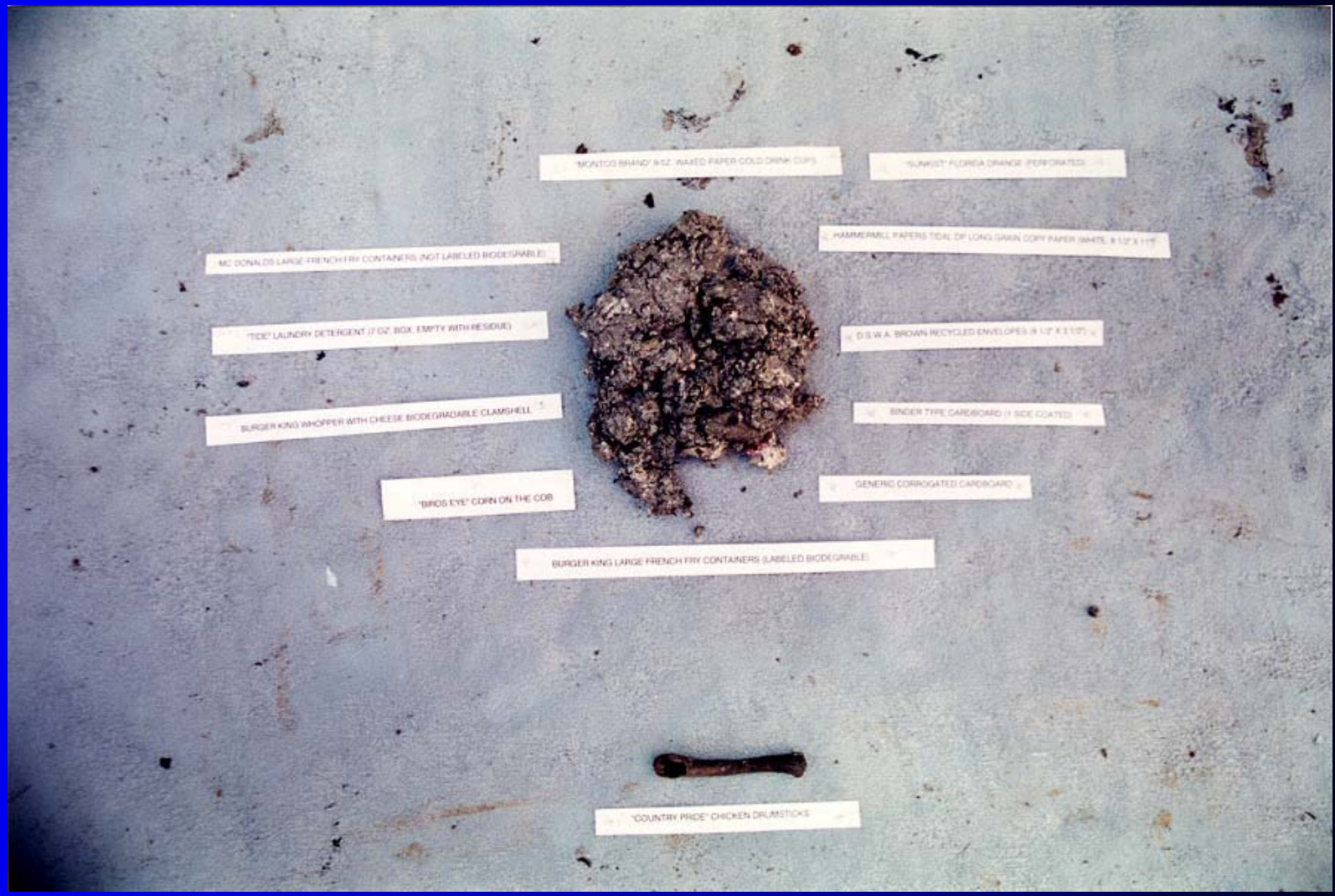


Material from control test cell time capsule



Chicken leg from control test cell time capsule

Material from bioreactor test cell time capsule

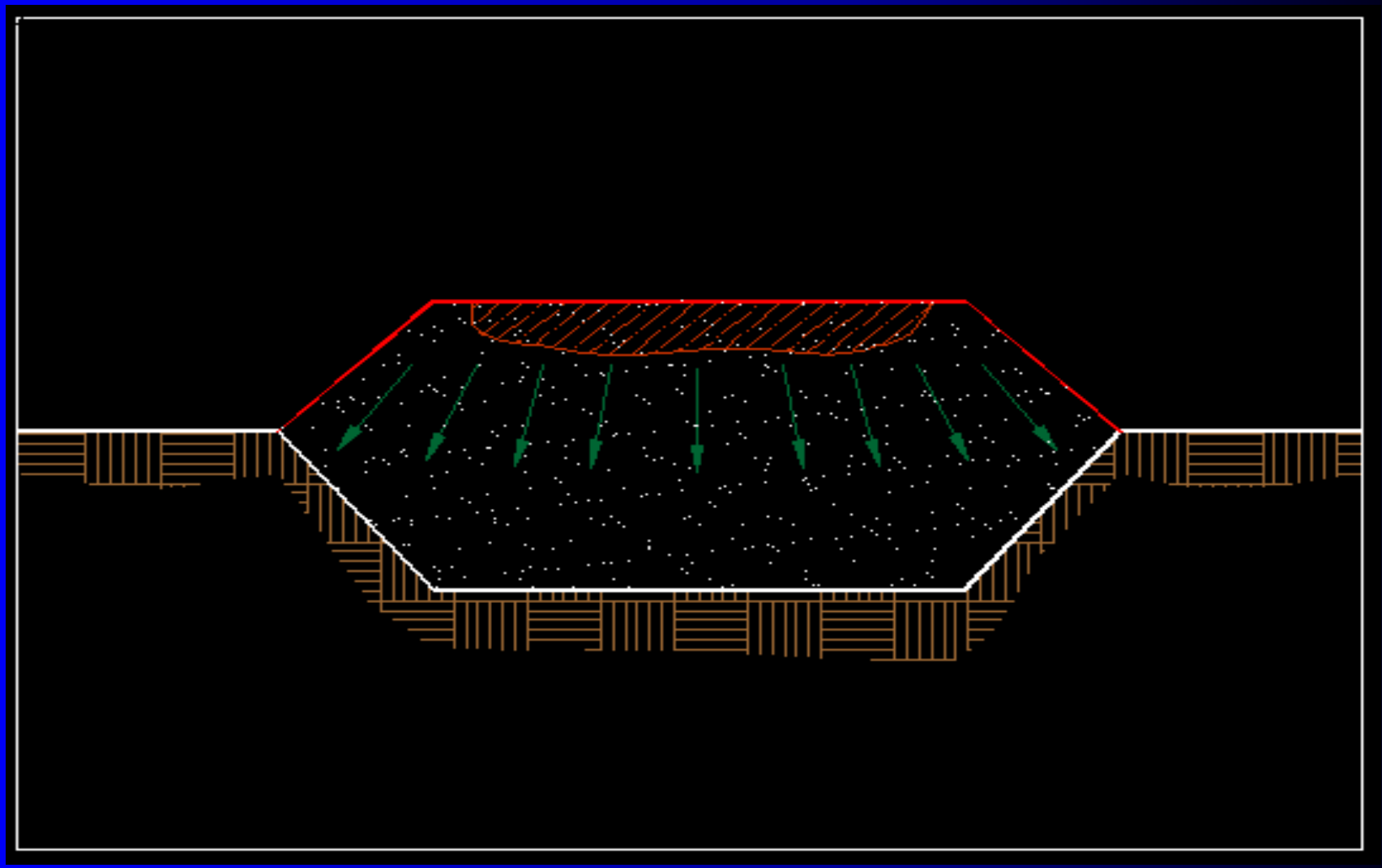



ENAMEL

Recirculation Methods

- Ponding
- Spraying
- Vertical Wells
- Leach Fields
- Horizontal Wells

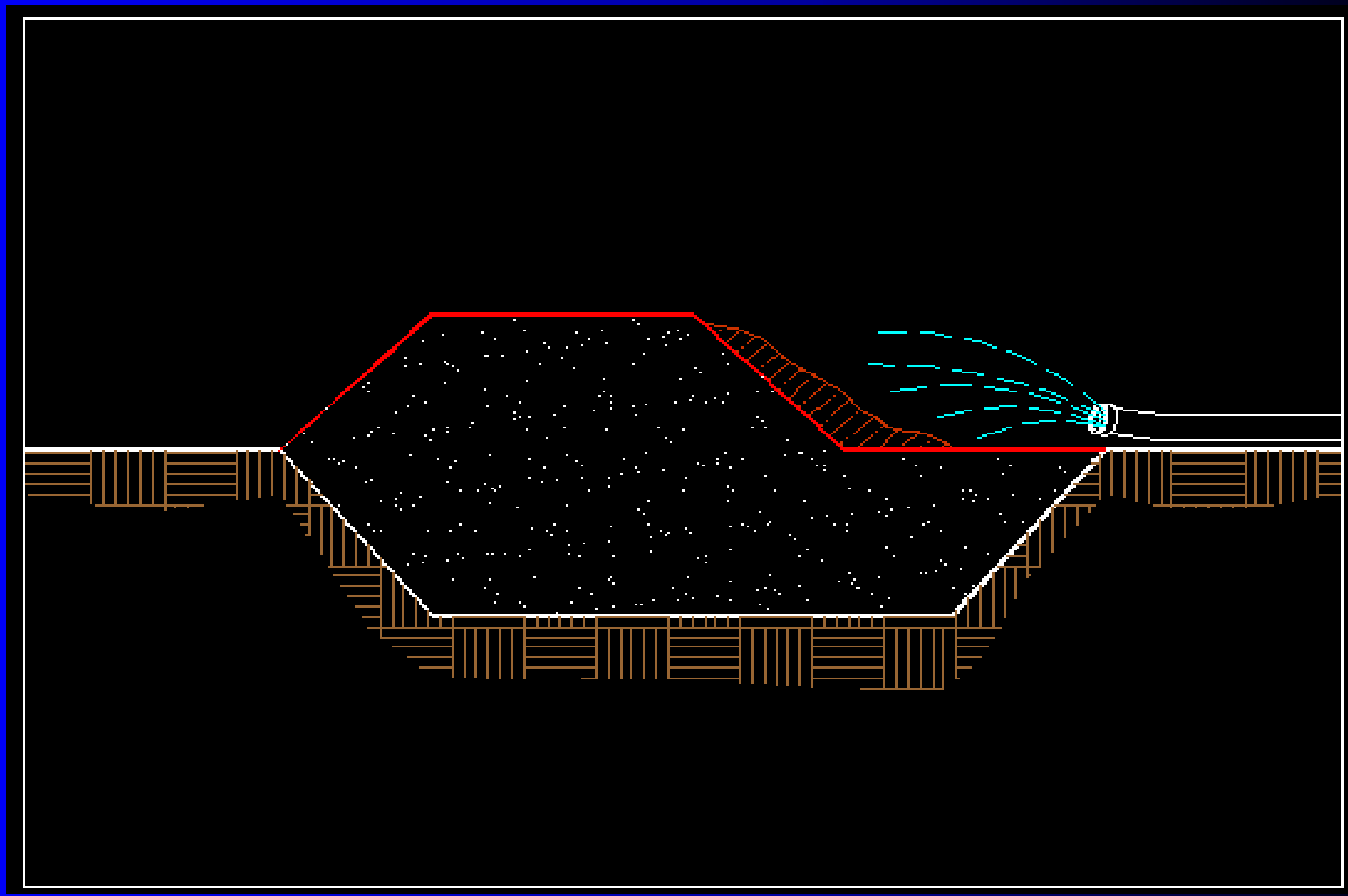
Ponding



Ponding

- Advantages
  - Low cost
  - Immediate implementation
  - Simple
- Disadvantages
  - Potential odors
  - Potential short-circuiting of liquids
  - Aesthetics

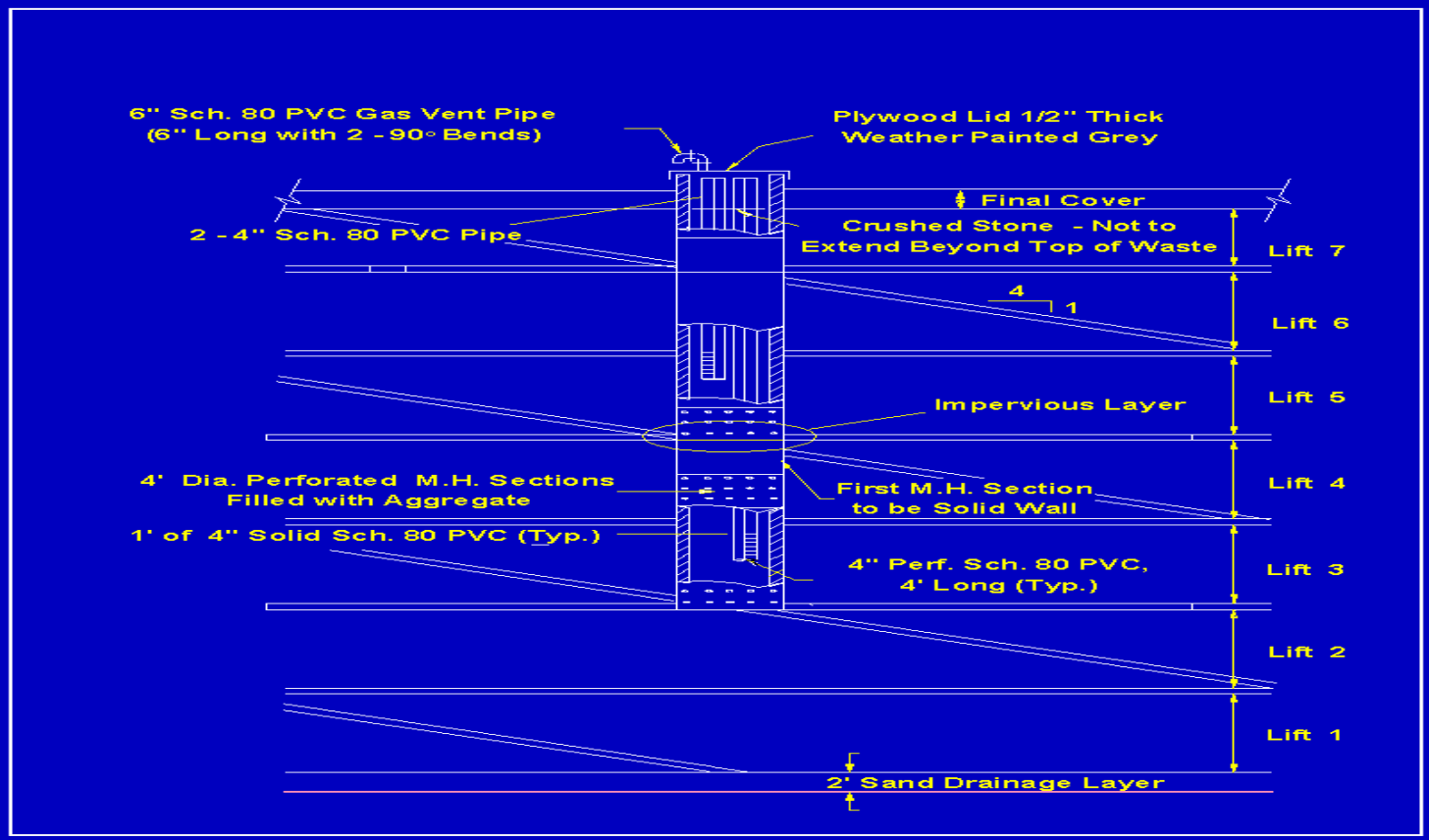
Spraying



Spraying

- Advantages
  - Low cost
  - Immediate implementation
  - Simple
  - Good distribution if done consistently
- Disadvantages
  - Potential odors
  - Can only be used while landfill is operating

Vertical Well

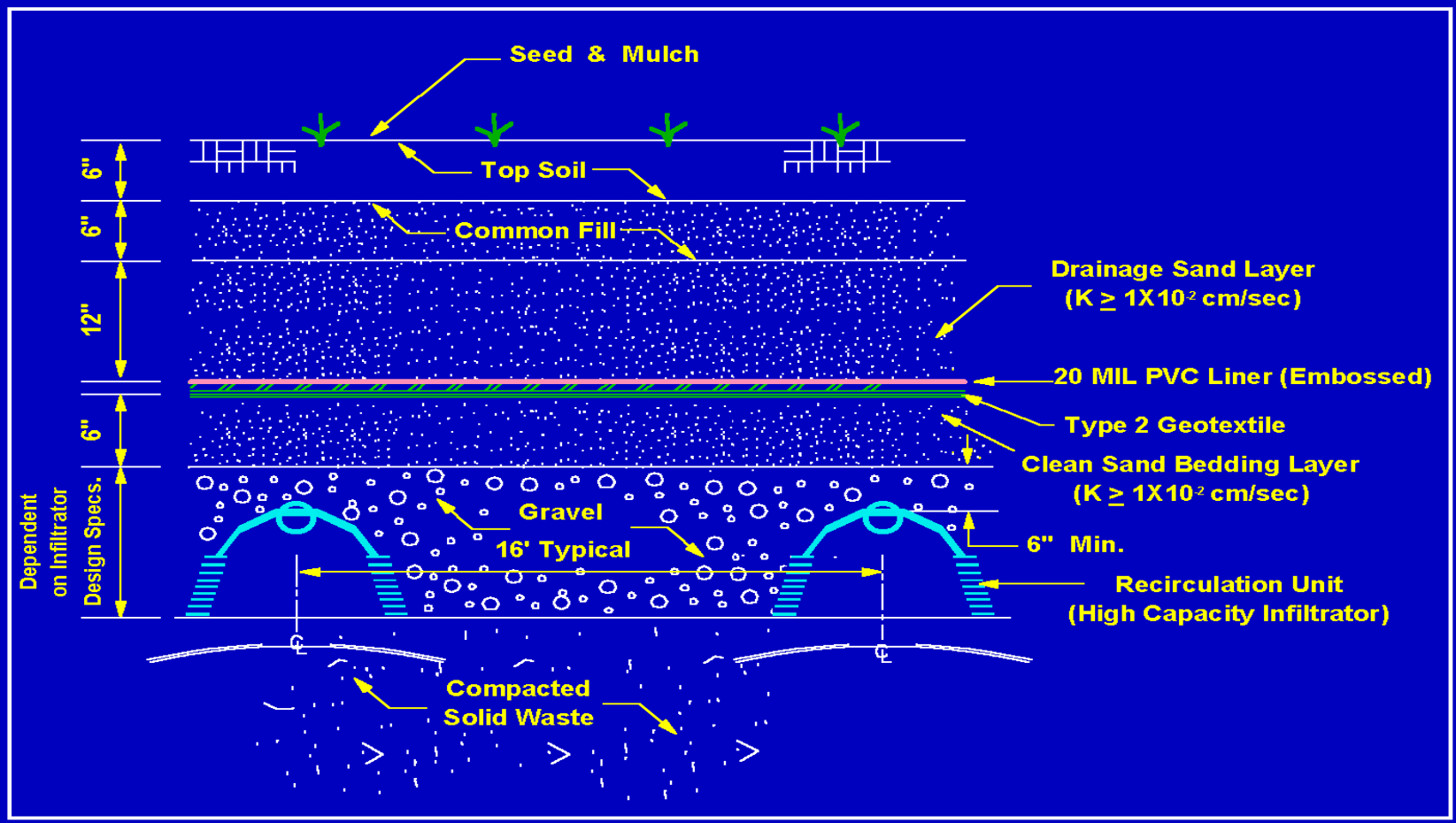


DSWA Sandtown Landfill: Typical Cross-Section - Area D Recirculation Well
(Constructed Between 1992 and 1999)

Vertical Wells

- Advantages
  - Moderate cost
  - Wells can be implemented relatively quickly
  - Can be implemented and used after landfill cell is completed
- Disadvantages
  - Potential flooding of LFG wells
  - Limited distribution

Leach Field

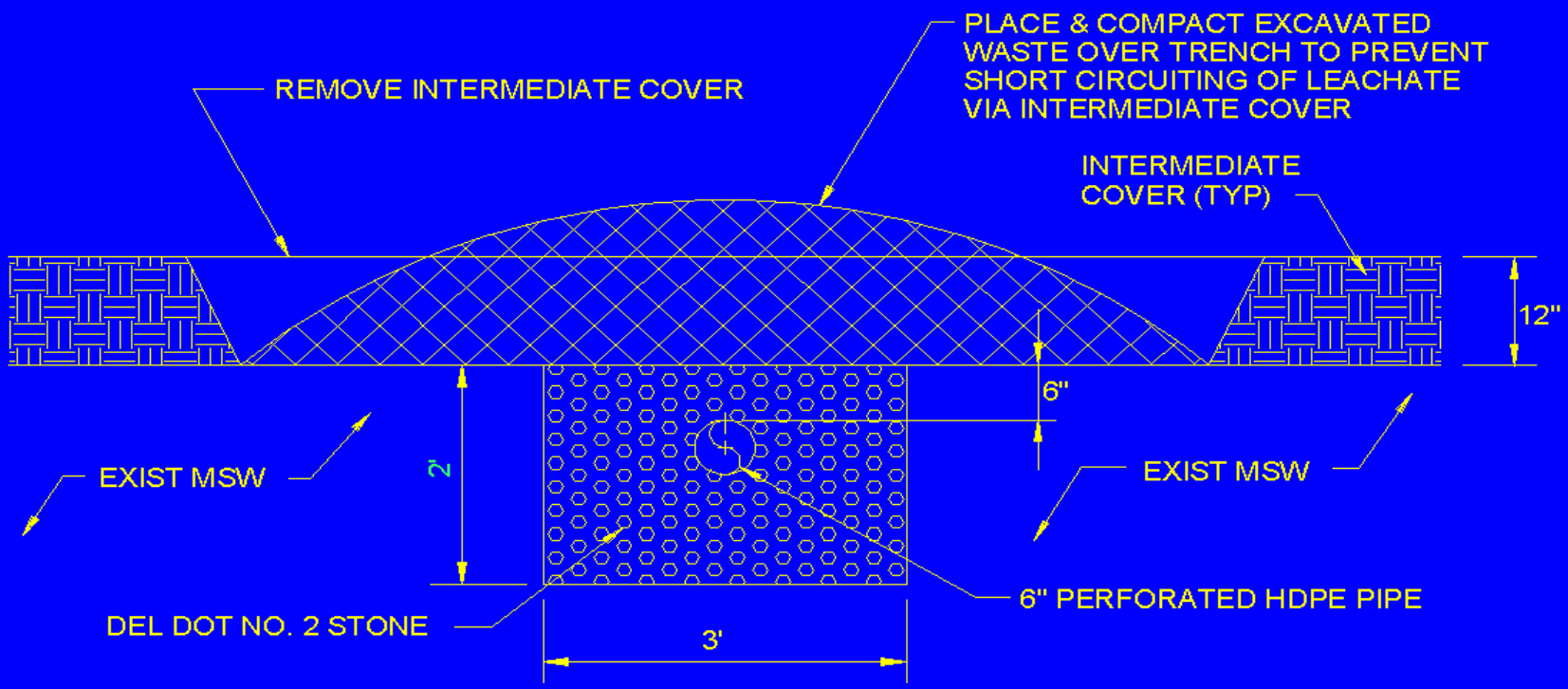


DSWA Sandtown Landfill: Area D: Typical Cross-Section - Area D Leach Field (1998)

Leach Field

- Advantages
  - Can be implemented and used after landfill cell is completed
- Disadvantages
  - Need to wait until landfill cell is complete

Horizontal Well



HORIZONTAL INJECTION TRENCH SECTION

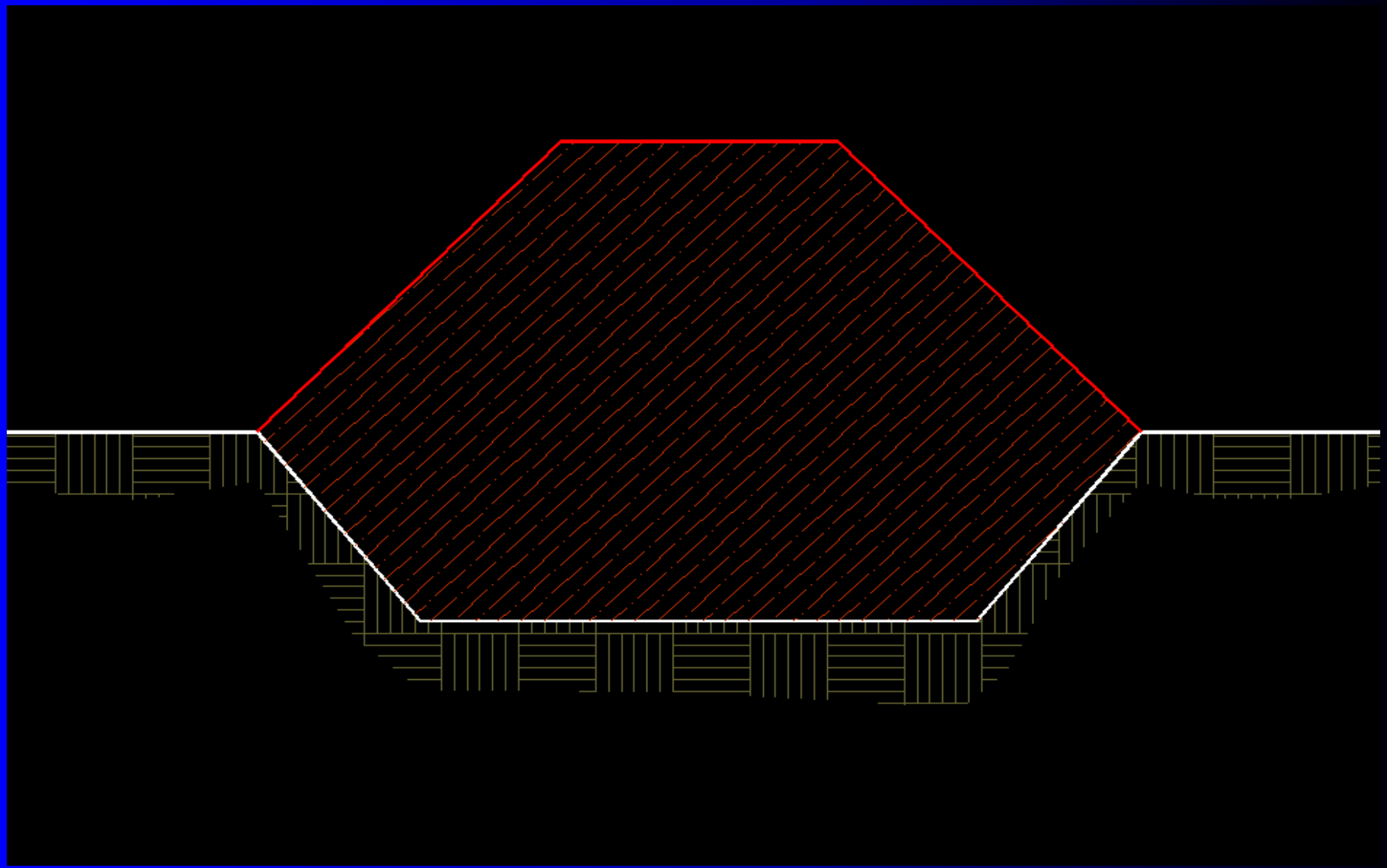
Horizontal Wells

- Advantages
  - Ability to recirculate significant quantities
  - Can be used after landfill cell is completed
- Disadvantages
  - Costs
  - Complicated

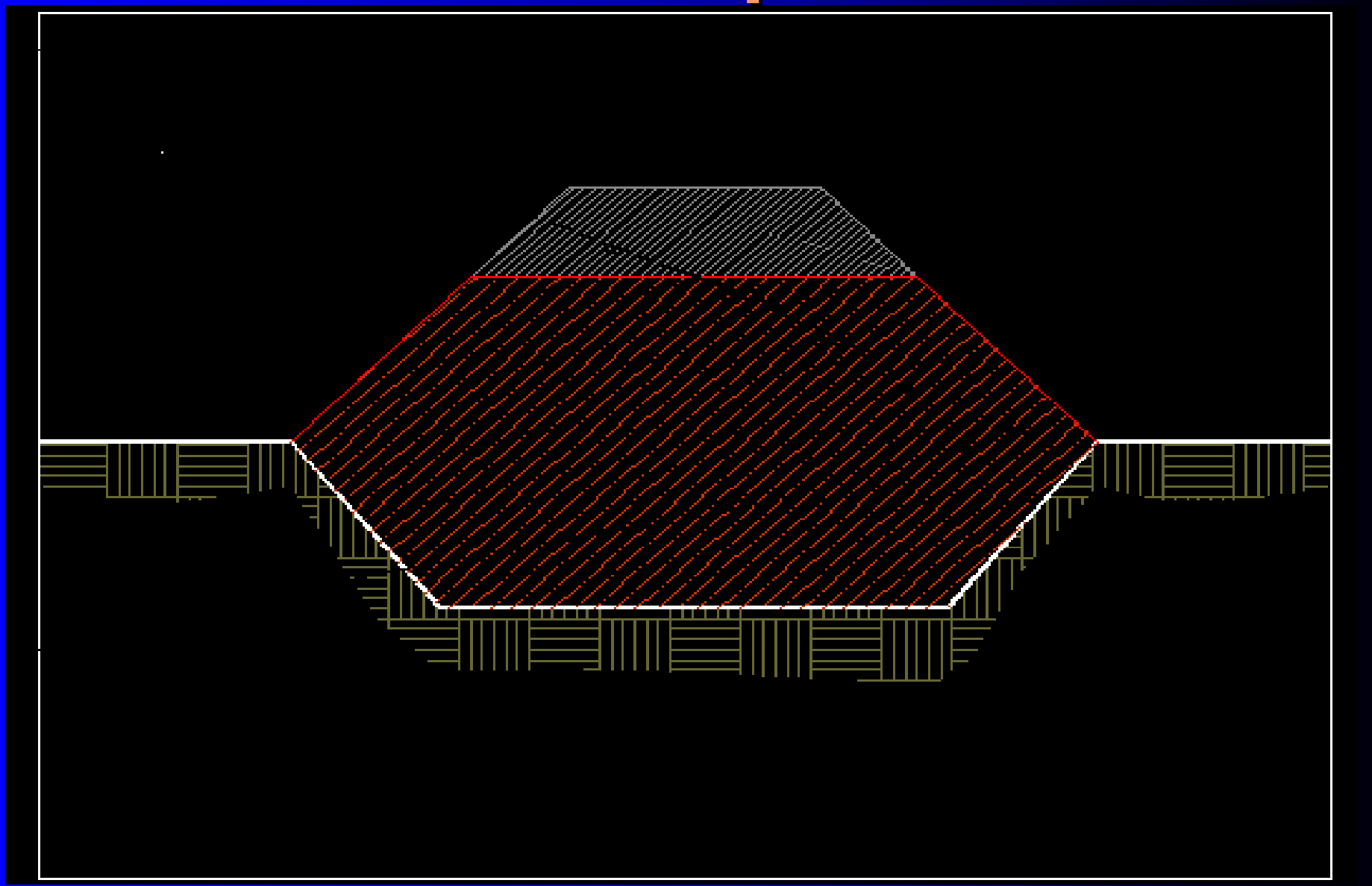
Potential Undesirable Impacts

- Increased LFG Generation
- Odors
- Flooding LFG Wells
- Leachate Seeps
- Loss of Air Space

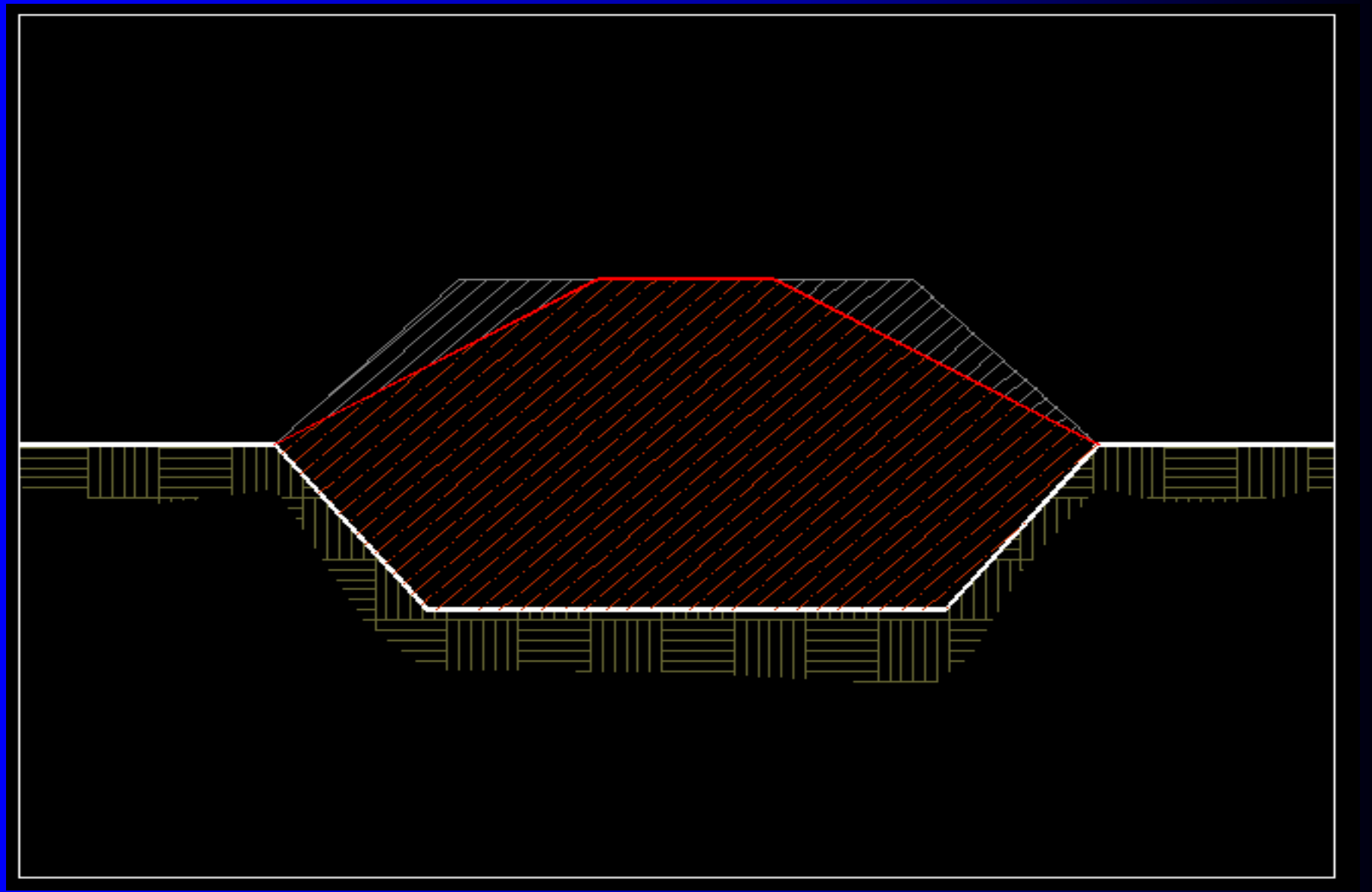
Loss of Airspace?



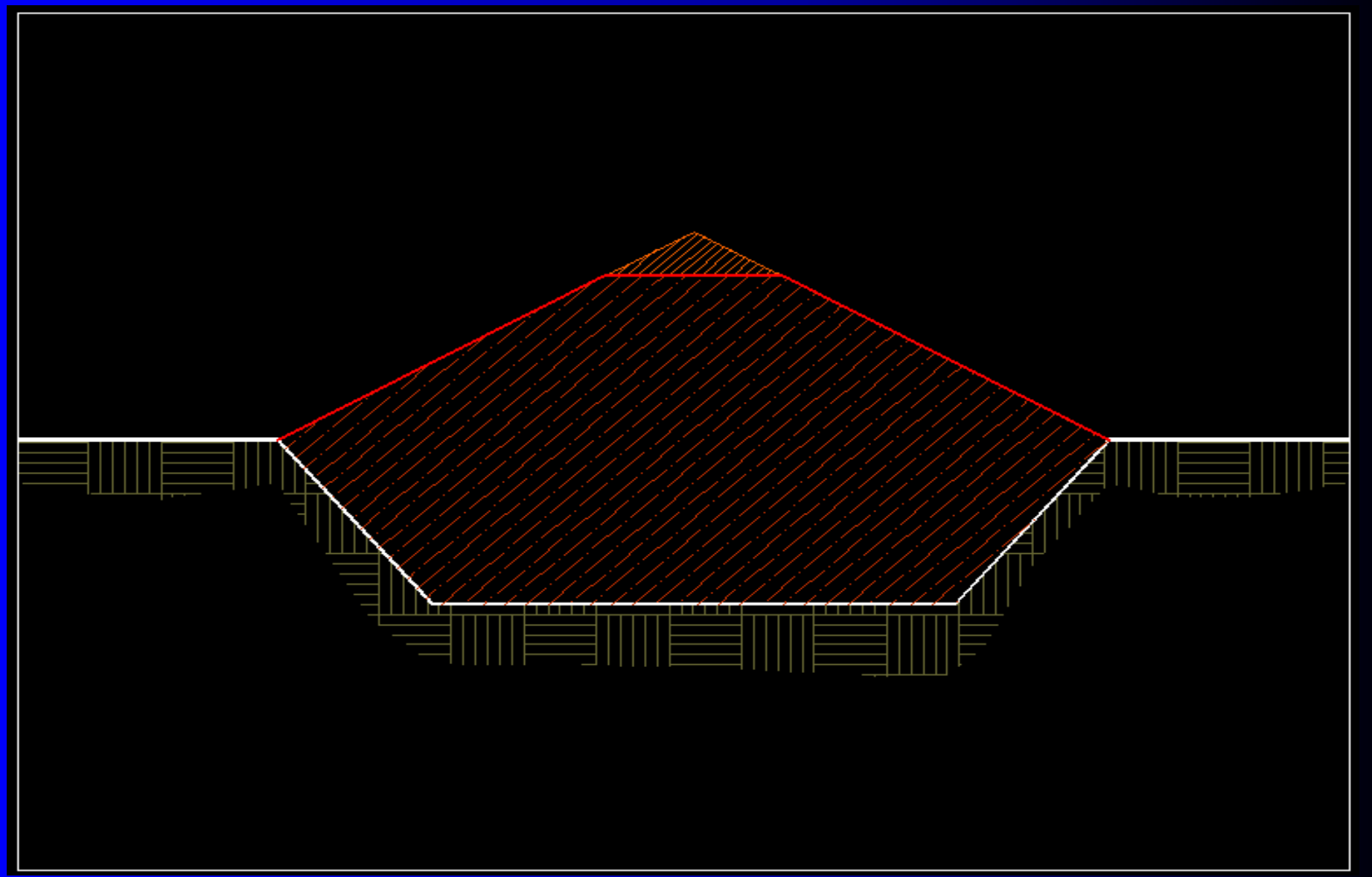
Loss of Airspace?



Loss of Airspace?

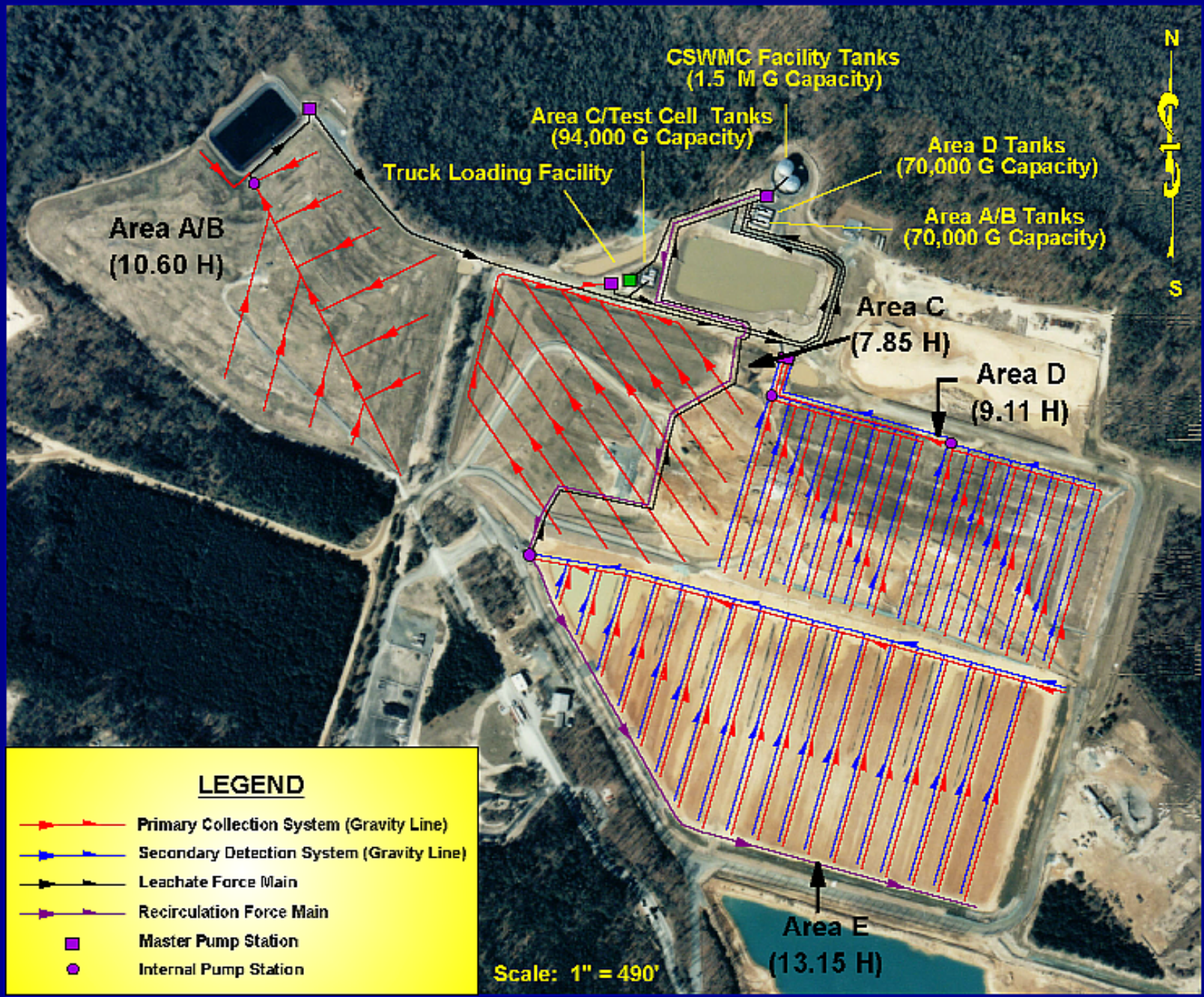


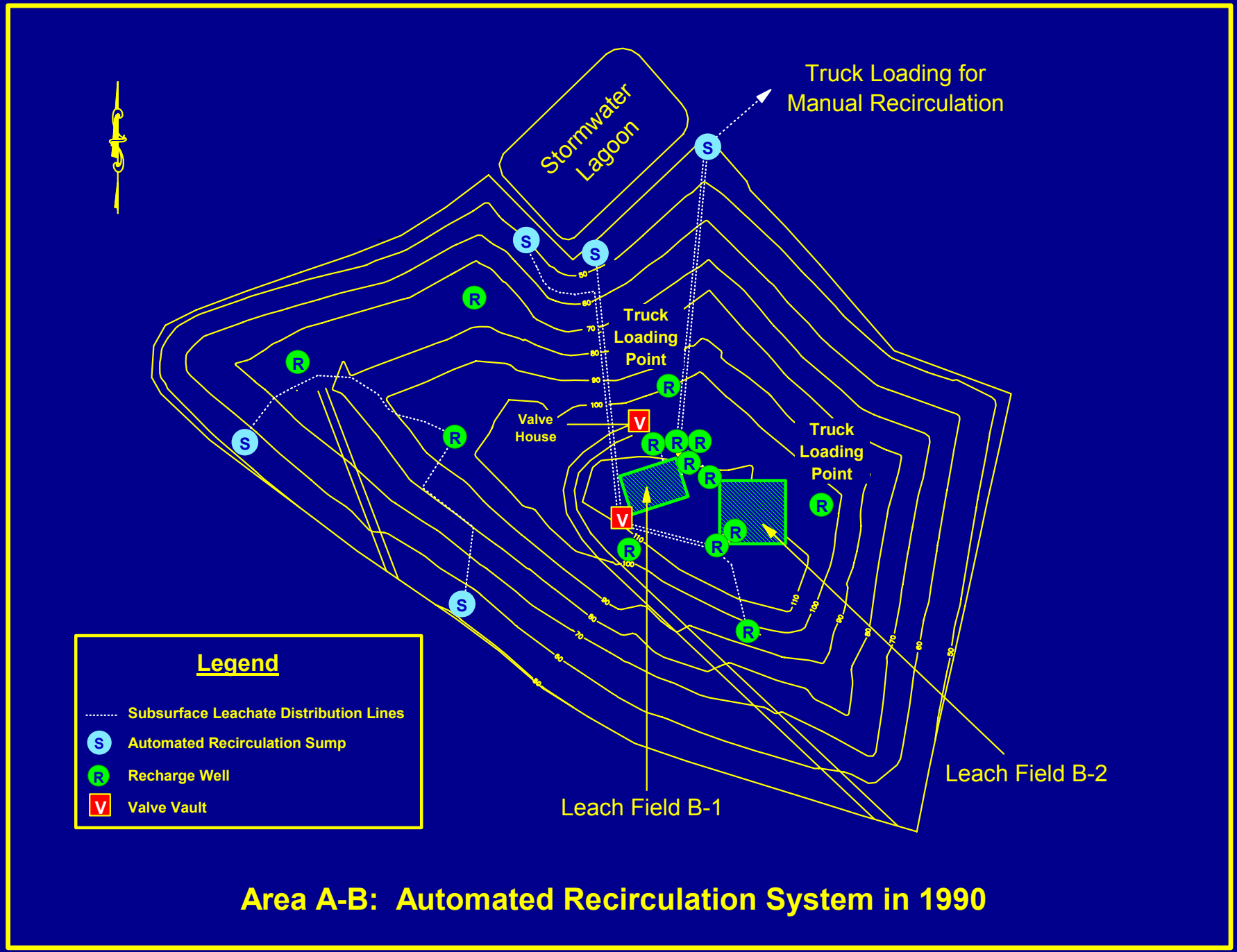
Loss of Airspace?



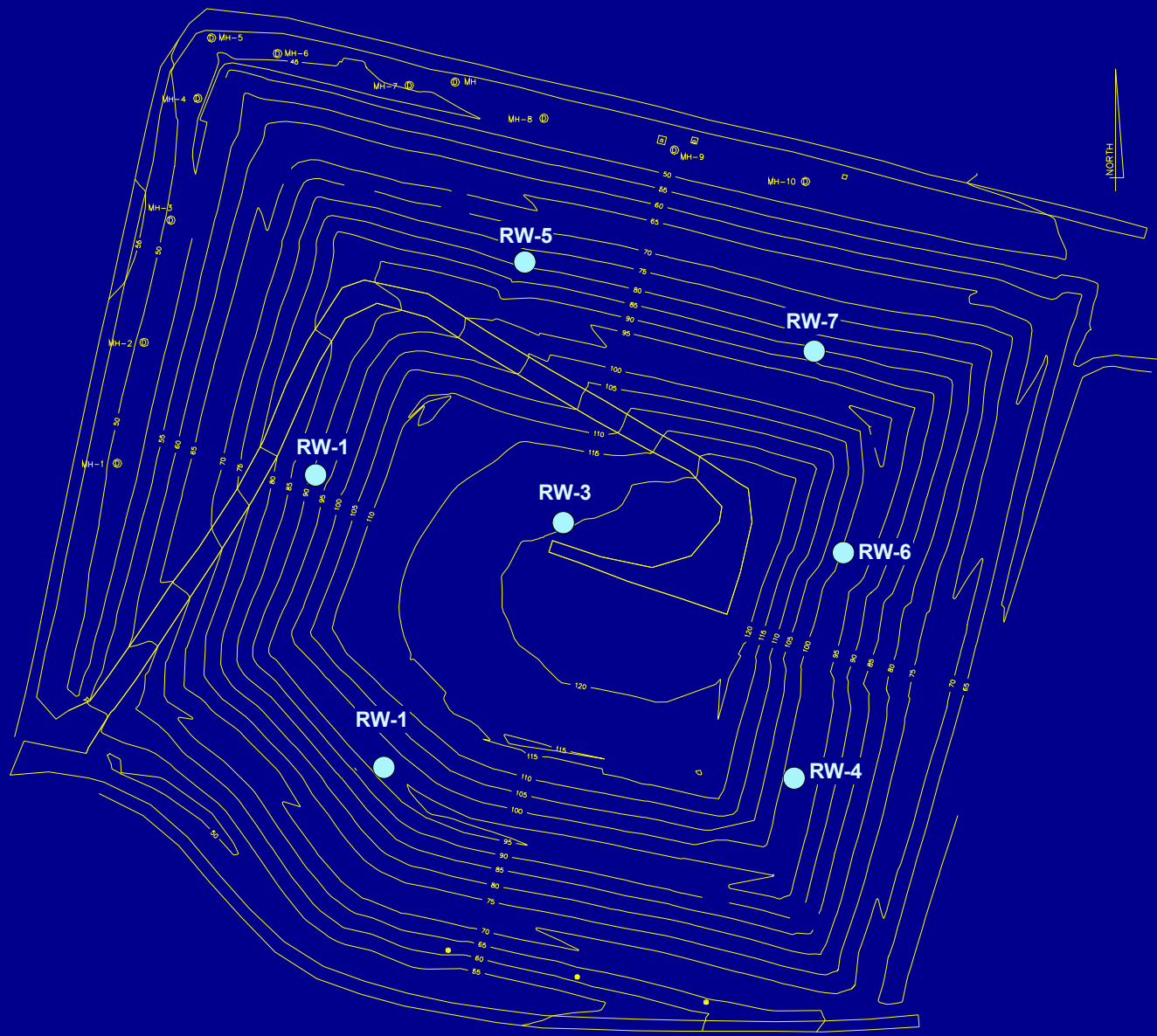

Lands of the
Delaware Solid Waste Authority at the
Central Solid Waste Management Center
in Sandtown, Delaware
Acres Hectares
Kent County Tracts A&B 84.56 34.22
Kalish Tract 298.68 120.87
Roe Tract 0.91 0.37
Thomas Tract 144.73 58.57
Dixon Tract 155.94 63.11
Dept. of Transportation Tract 86.44 34.98
Total 771.26 312.12
Caroline County, Maryland
Kent County, Delaware
Kent County Tract A
Kalish Tract
Area A/B
Area C
Area D
Area E
DOT Tract
Thomas Tract
Dixon Tract
Kent County Tract B
Roe Tract

Plan View of Facility Leachate Collection Systems

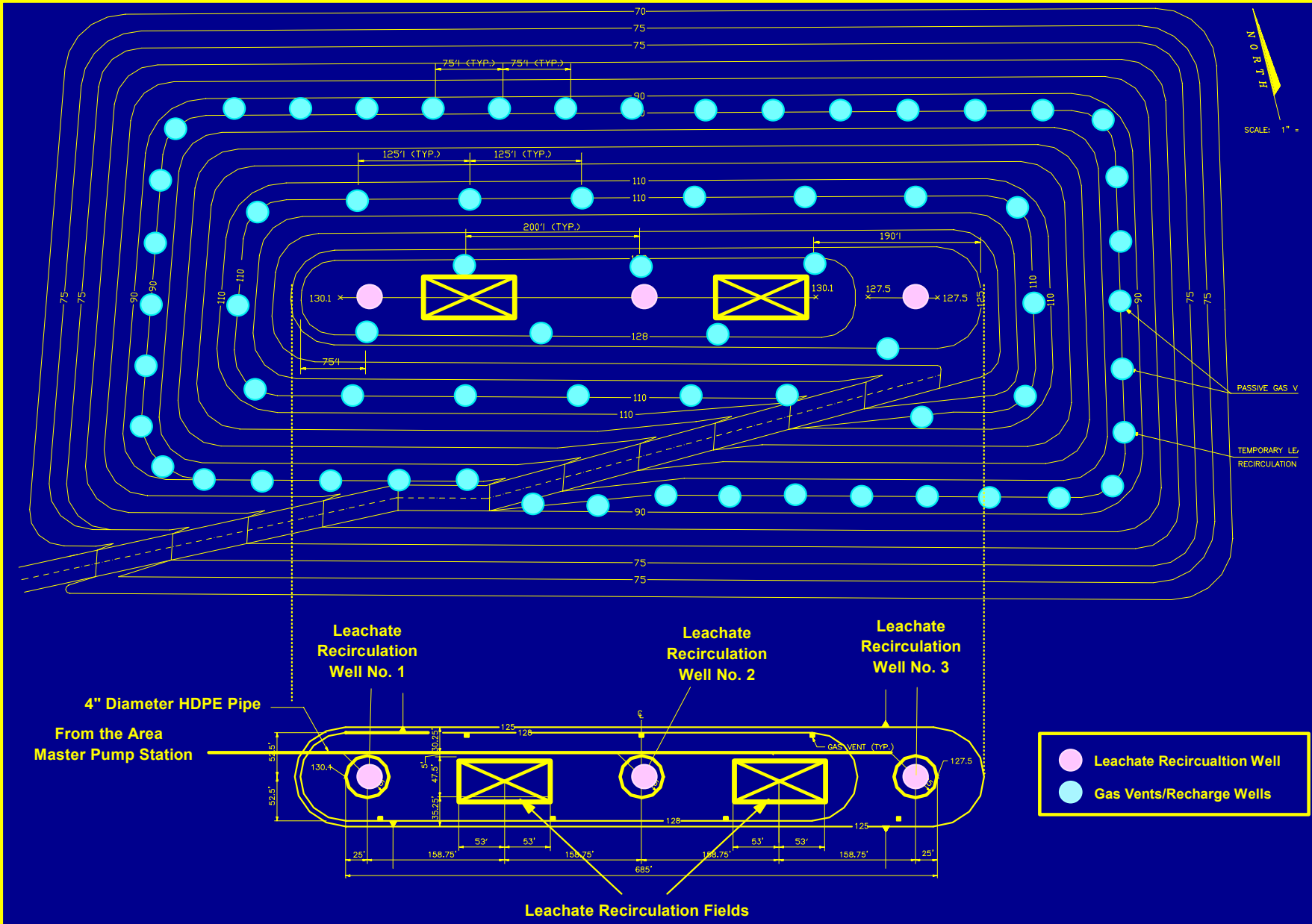




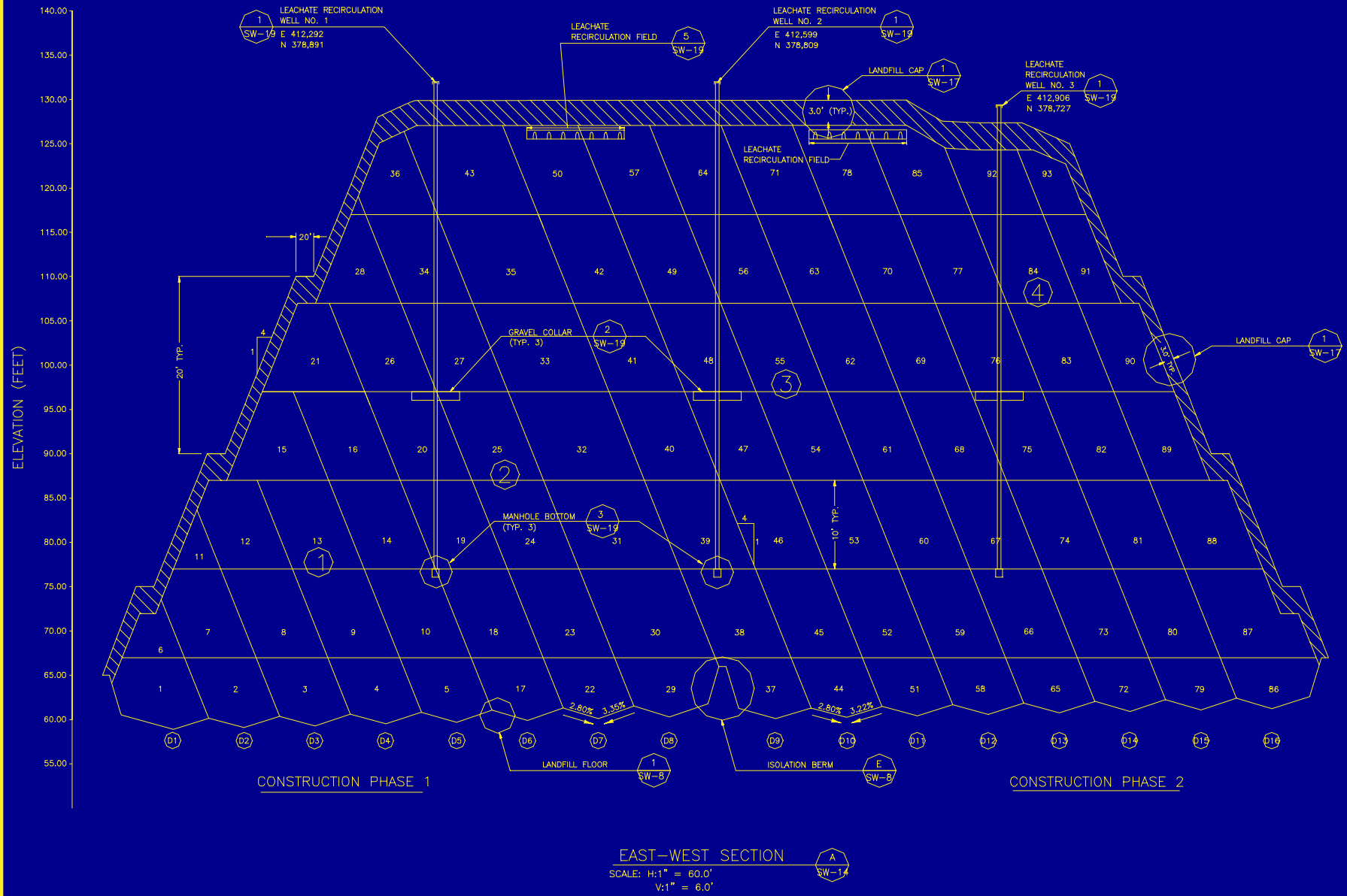
Area A-B: Automated Recirculation System in 1990



Area C: Location of Leachate Recharge Wells (Manually Loaded)



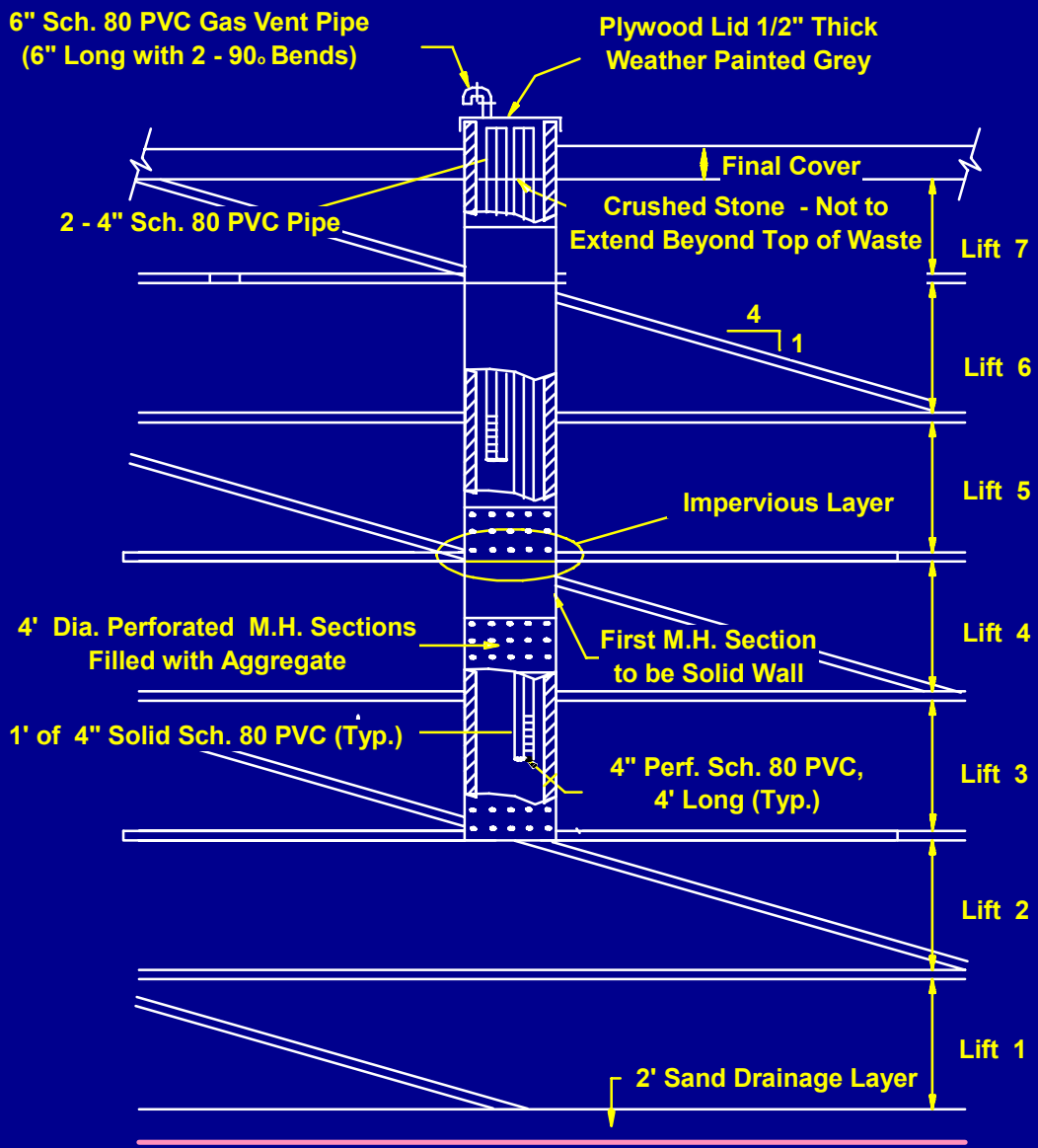
Plan View if the Area D Leachate Recirculation System



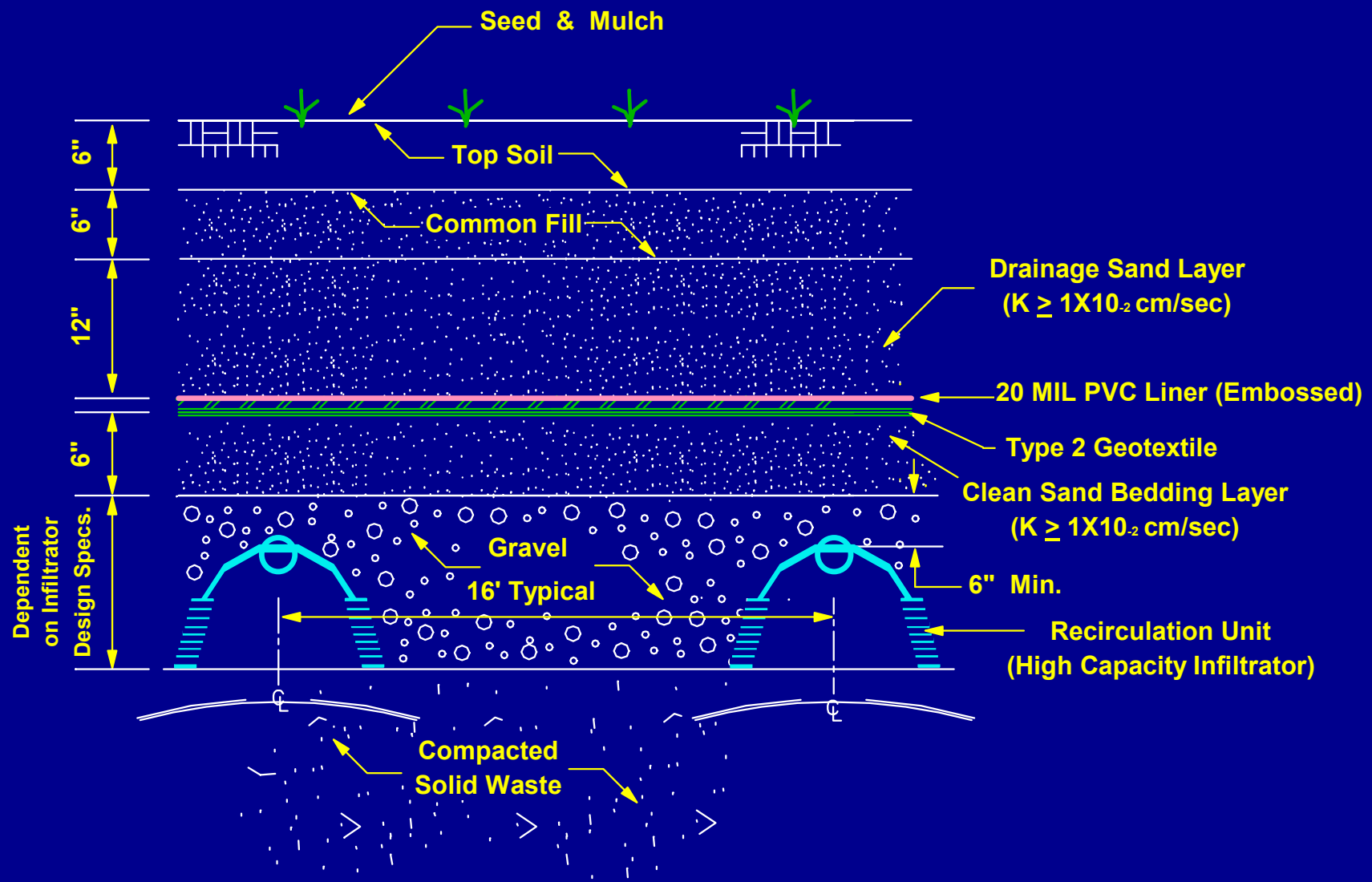
EAST–WEST SECTION

SCALE: H:1" = 60.0'
V:1" = 6.0'

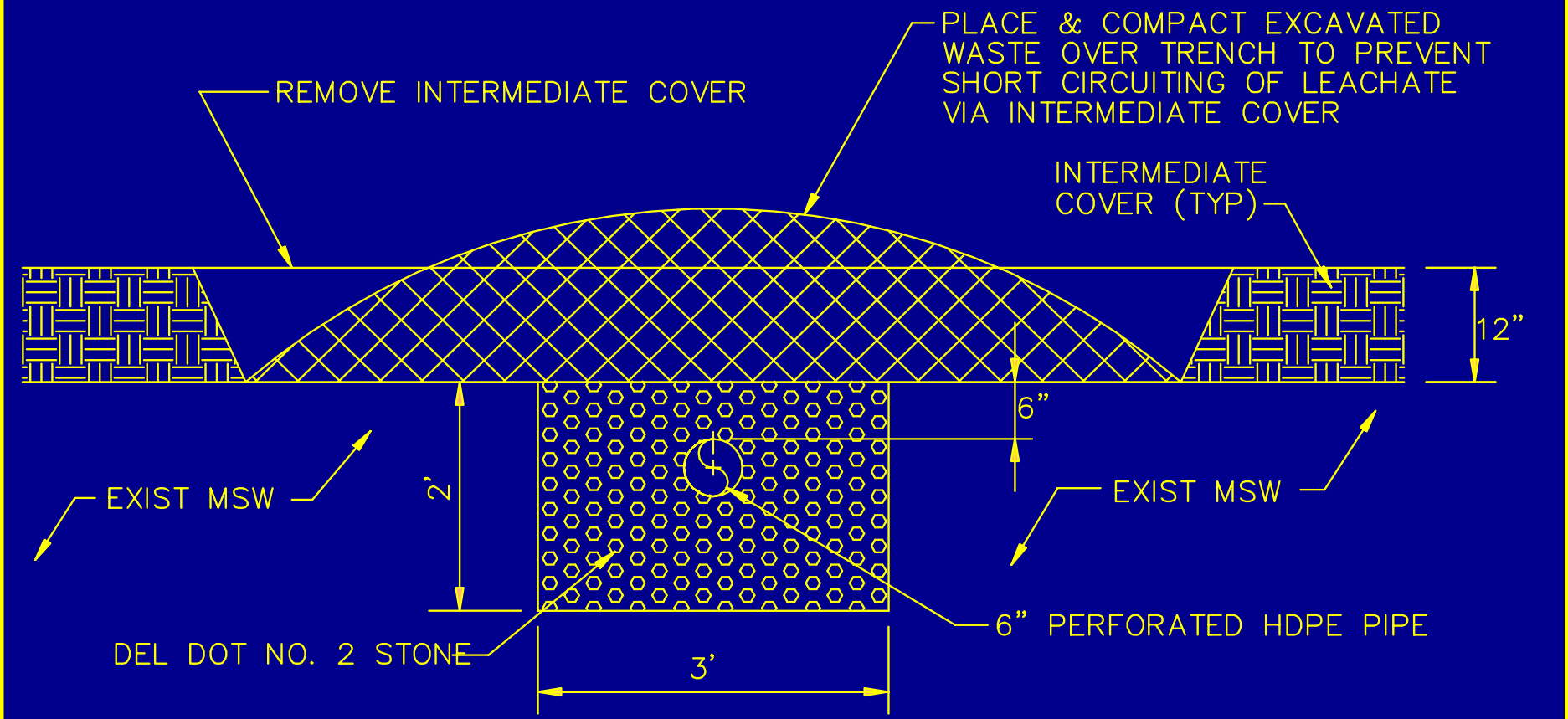
Area D: Cross Section of Recirculation System



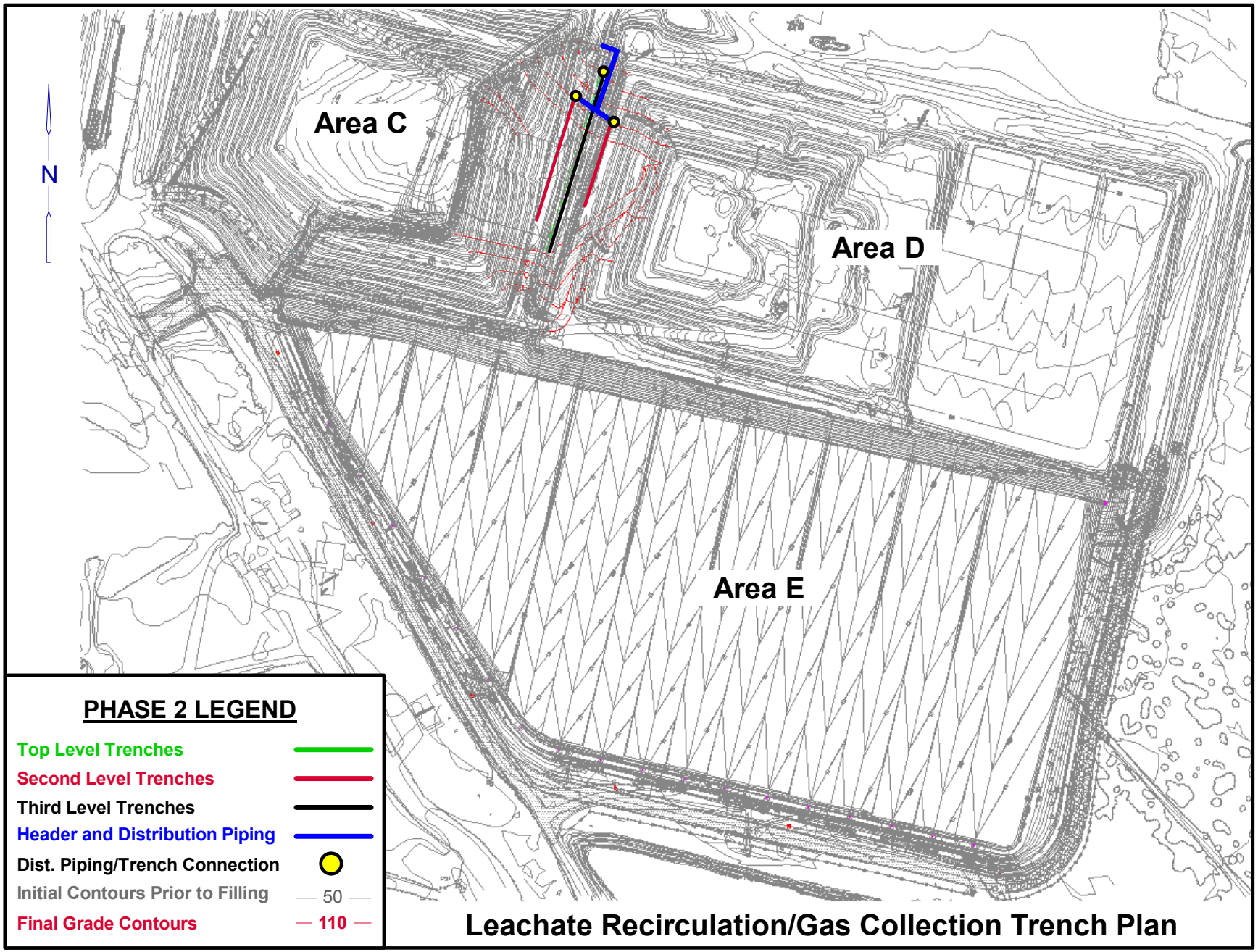
Typical Cross-Section - Area D Recirculation Well

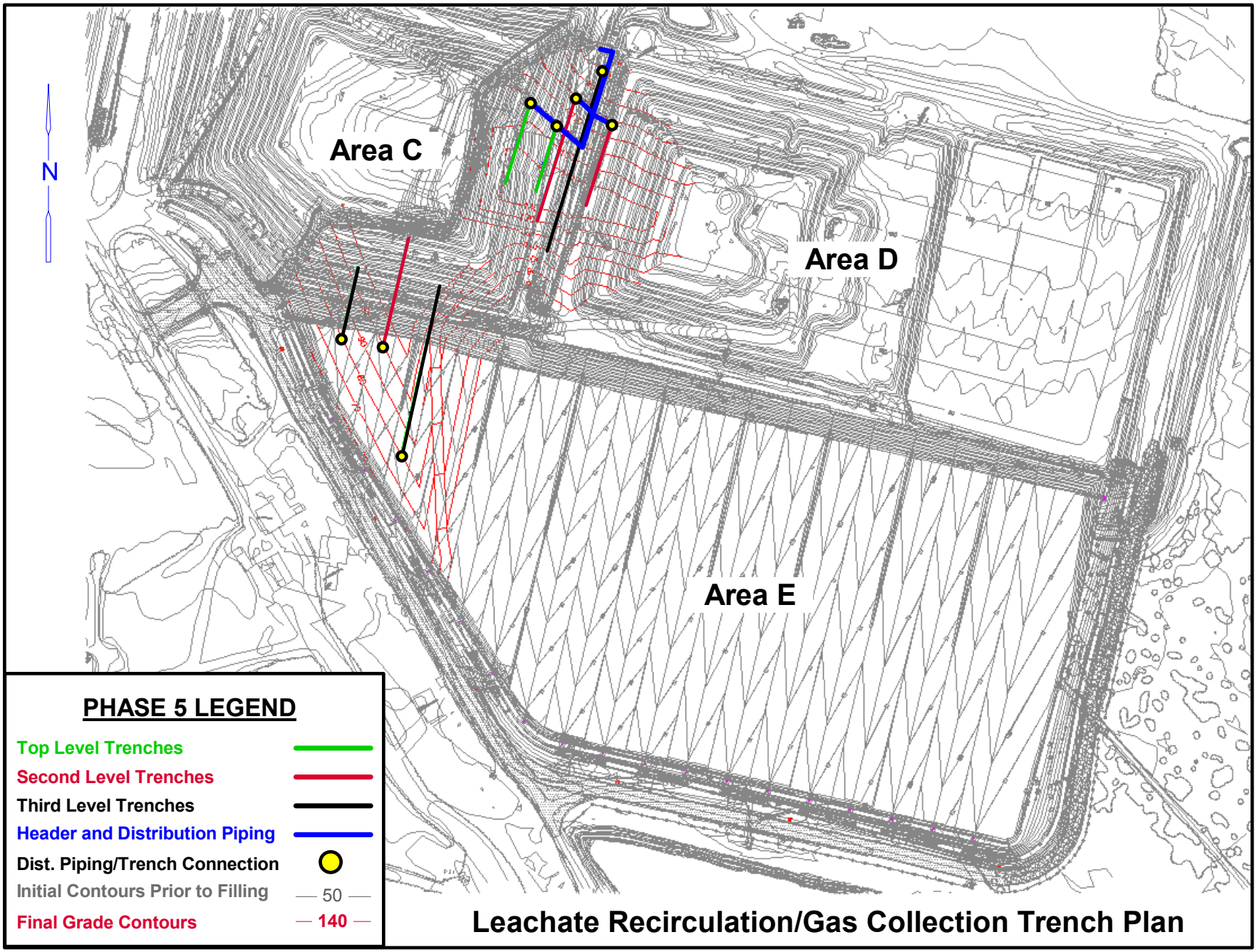


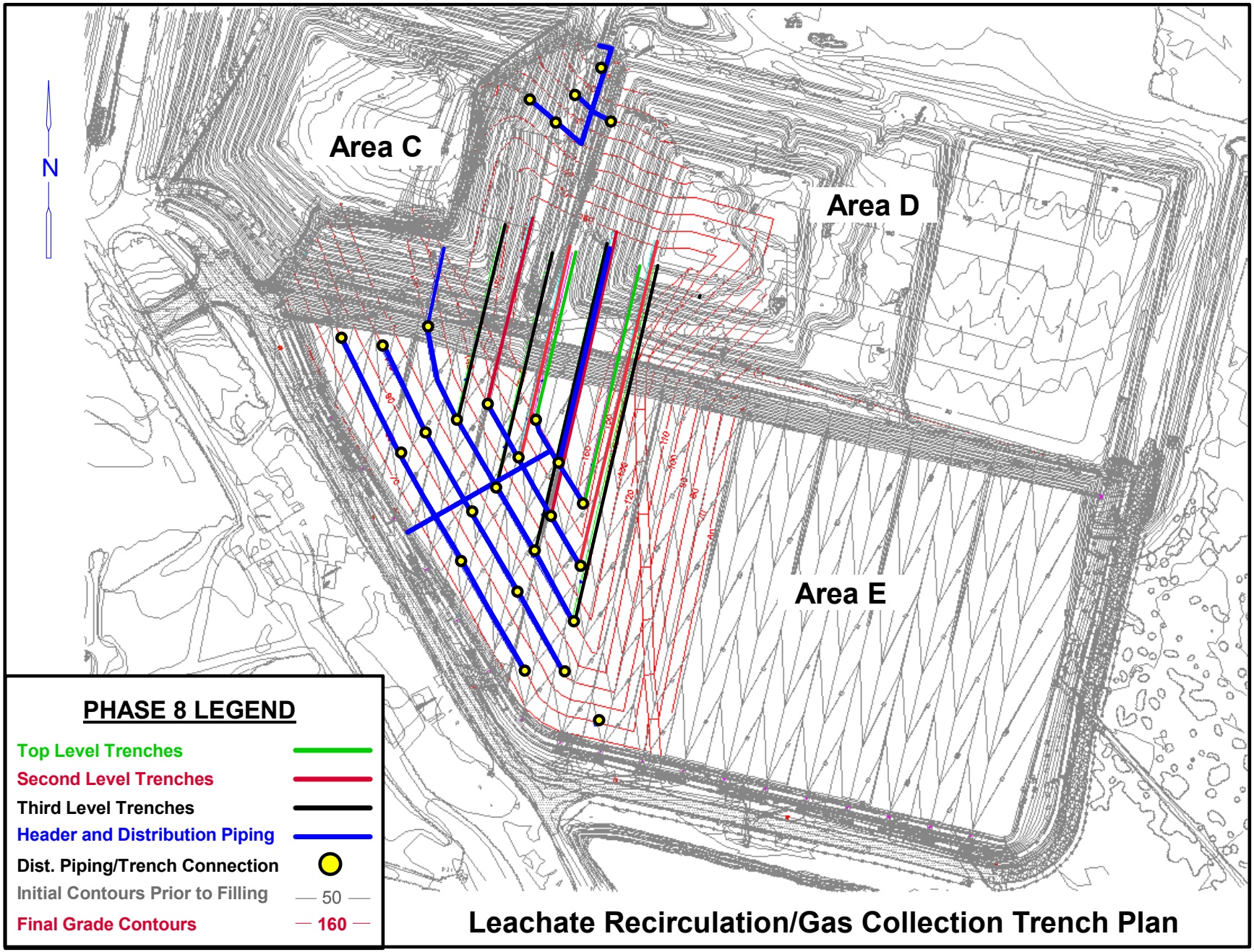
Typical Cross-Section - Area D Leach Field

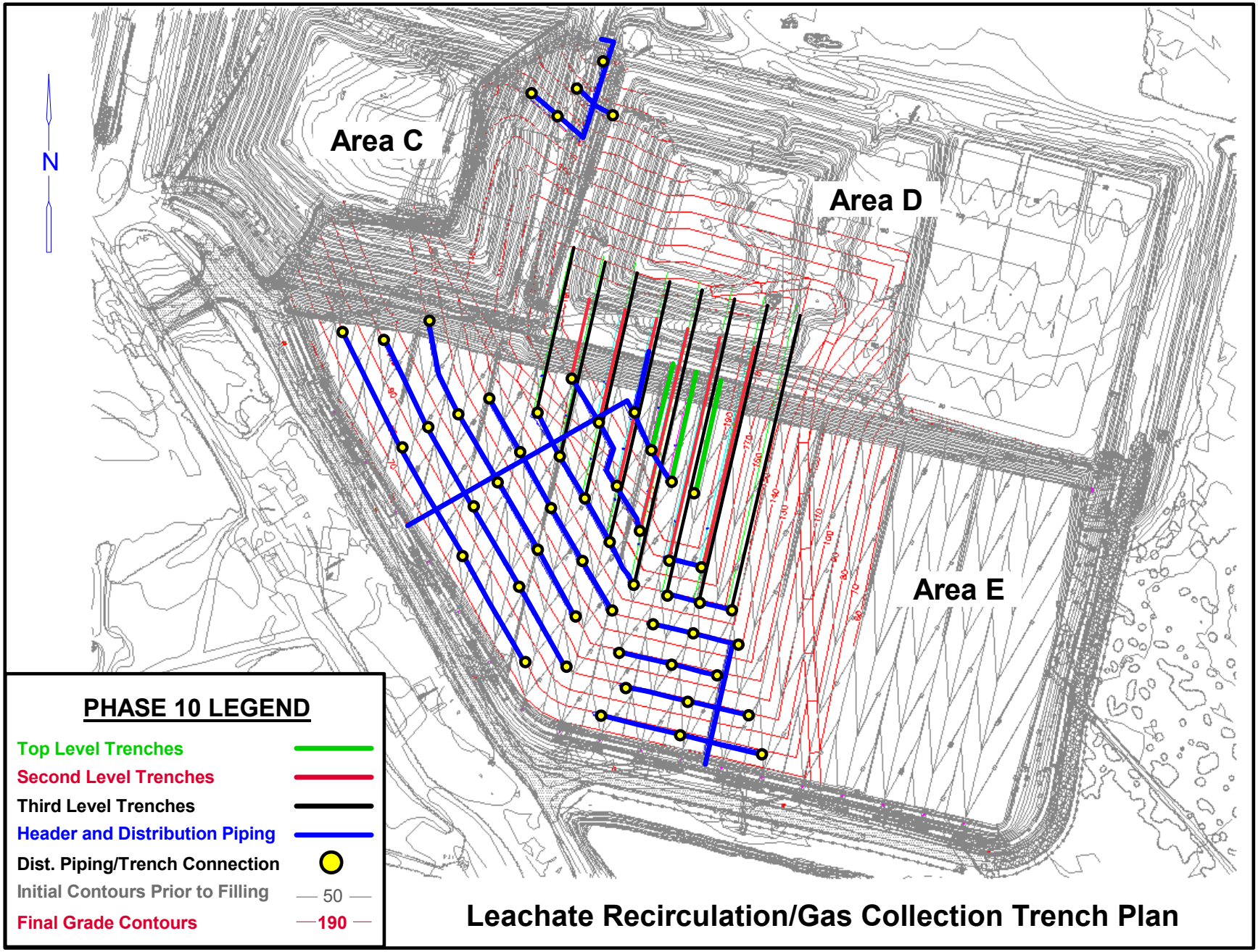


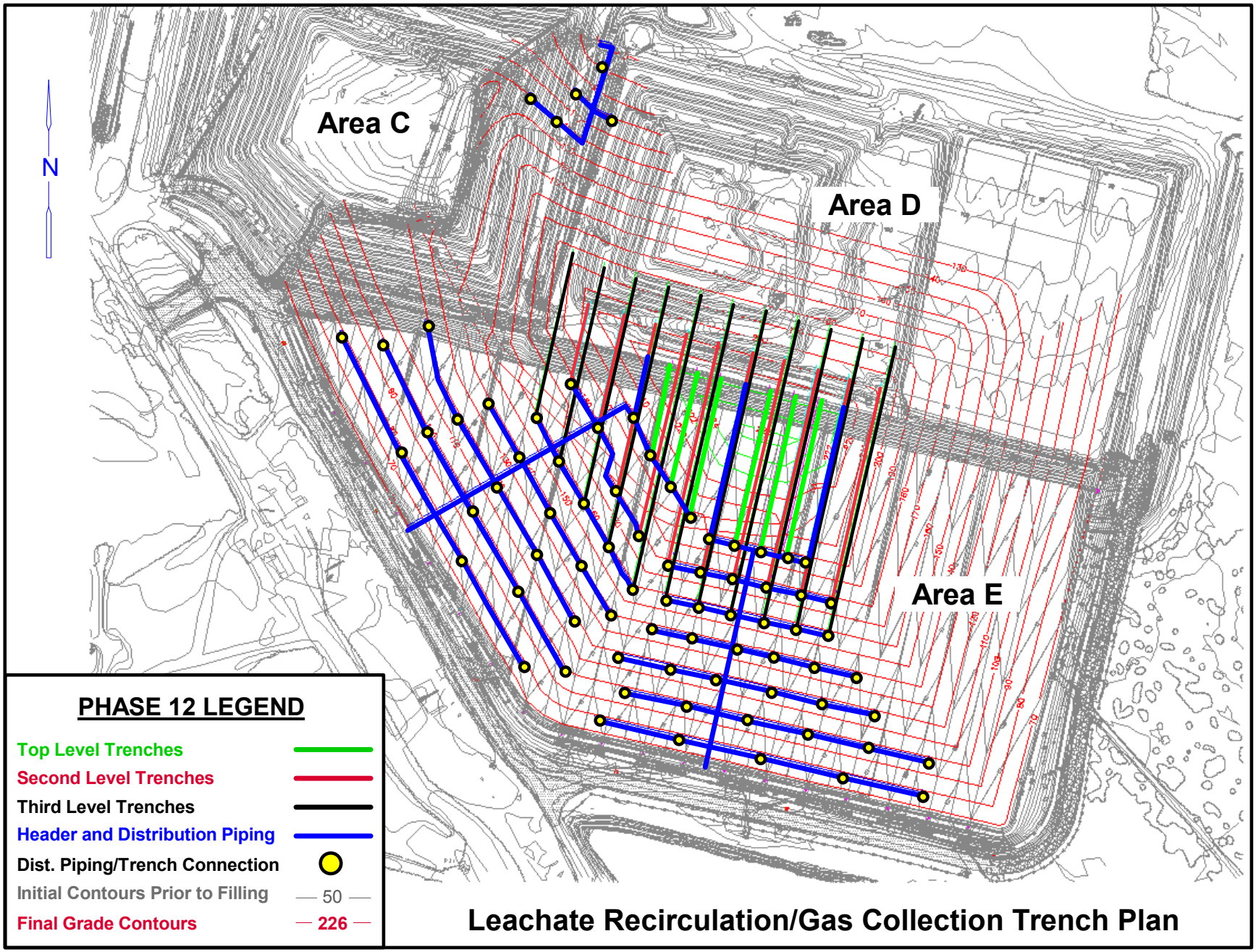
Horizontal Injection Trench Detail

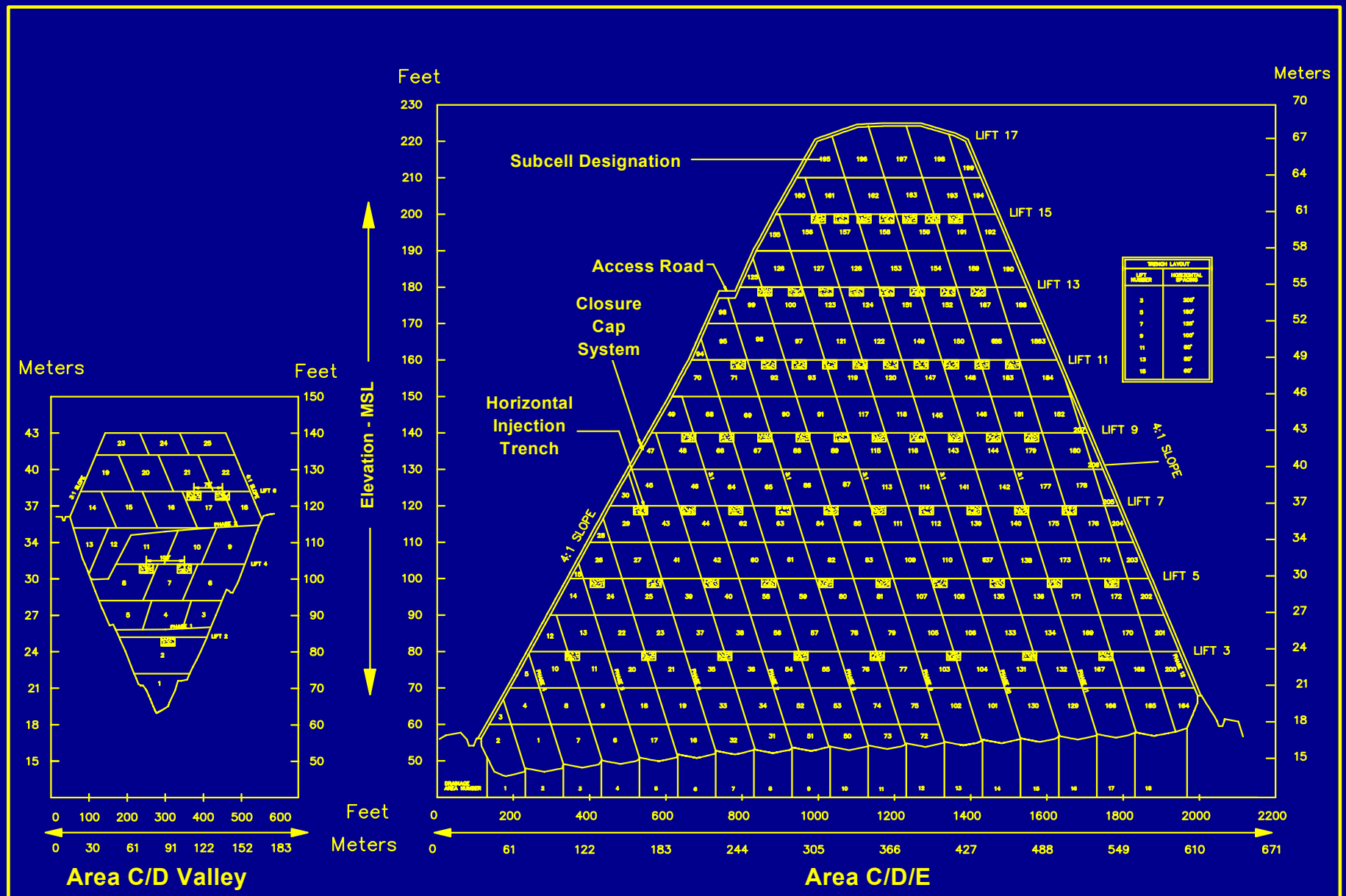

N
Area C
Area D
Area E
PHASE 2 LEGEND
Top Level Trenches
Second Level Trenches
Third Level Trenches
Header and Distribution Piping
Dist. Piping/Trench Connection
Initial Contours Prior to Filling
50
Final Grade Contours
110
Leachate Recirculation/Gas Collection Trench Plan


N
Area C
Area D
Area E
PHASE 5 LEGEND
Top Level Trenches
Second Level Trenches
Third Level Trenches
Header and Distribution Piping
Dist. Piping/Trench Connection
Initial Contours Prior to Filling
50
Final Grade Contours
140
Leachate Recirculation/Gas Collection Trench Plan

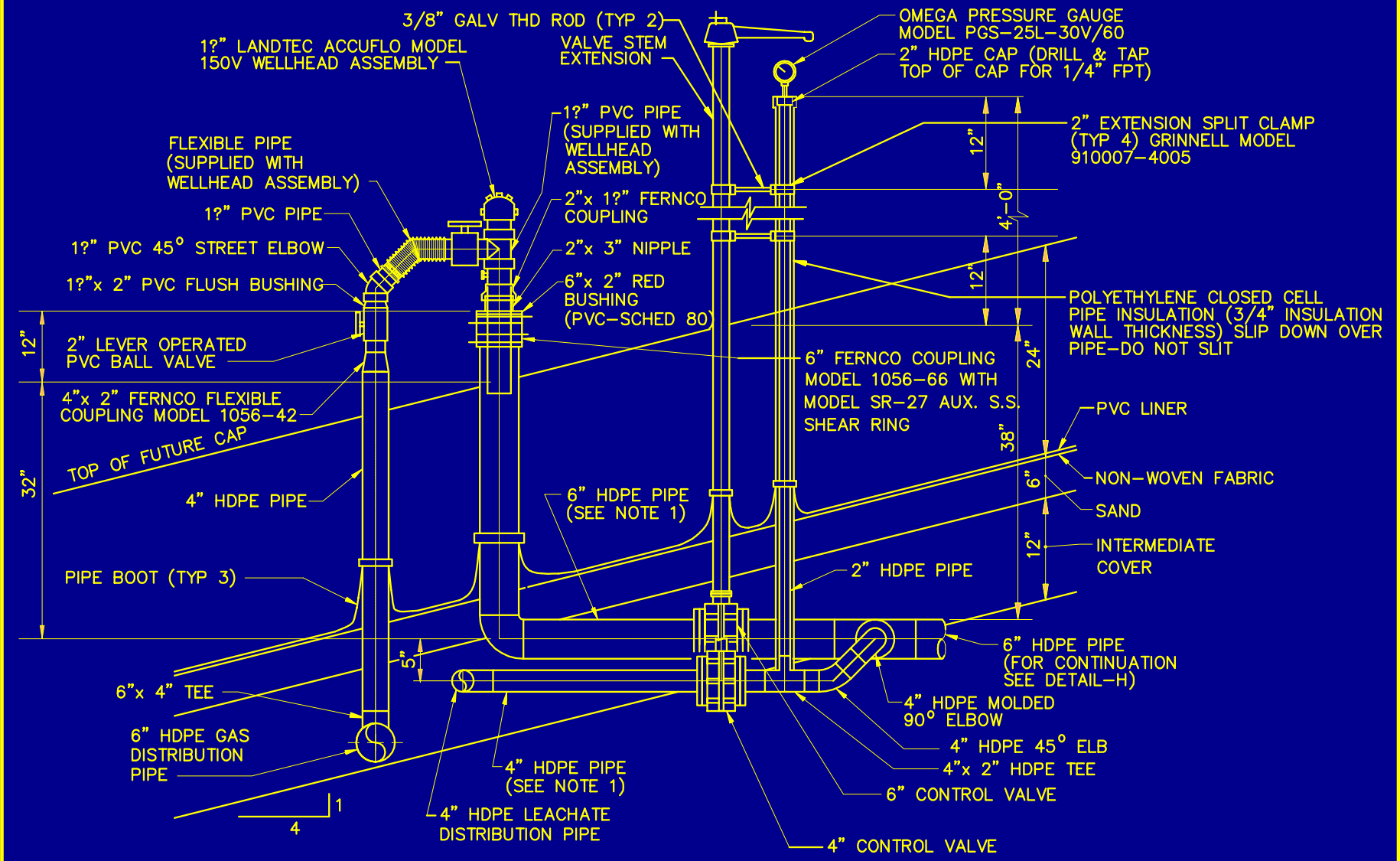

N
Area C
Area D
Area E
PHASE 8 LEGEND
Top Level Trenches
Second Level Trenches
Third Level Trenches
Header and Distribution Piping
Dist. Piping/Trench Connection
Initial Contours Prior to Filling
50
Final Grade Contours
160
Leachate Recirculation/Gas Collection Trench Plan


N
Area C
Area D
Area E
PHASE 10 LEGEND
Top Level Trenches
Second Level Trenches
Third Level Trenches
Header and Distribution Piping
Dist. Piping/Trench Connection
Initial Contours Prior to Filling
50
Final Grade Contours
190
Leachate Recirculation/Gas Collection Trench Plan


N
Area C
Area D
Area E
PHASE 12 LEGEND
Top Level Trenches
Second Level Trenches
Third Level Trenches
Header and Distribution Piping
Dist. Piping/Trench Connection
Initial Contours Prior to Filling
50
Final Grade Contours
226
Leachate Recirculation/Gas Collection Trench Plan



Filling Sequence for the C/D Valley and Area C/D/E



Distribution Piping/Trench Connection Detail - Side View

Horizontal Well Operations

- When to start?
- When to stop?
- When to start again?
- How to integrate with LFG collection system?

Leachate Recirculation History

	Total MSW Tonnage	Leachate Recirculated (Mgals)
Area A & B	697,000	21.6
Area C	631,000	4.1
Test Cells	18,000*	0.5
Area D	595,000	4.0
C/D Valley	143,000	1.4
Area E	408,000	0
TOTALS	**2,474,000**	**31.6**

Current Situation (2002)

	Leachate Collected (gals)	Leachate Recirculated (gals)	Leachate Treated Offsite (gals)	Treatment Cost
Area A & B	3,968,000	0	3,968,000	$220,000
Area C	1,069,000	0	1,069,000	$60,000
Area D	1,131,000	487,000	0	0
C/D Valley	0	734,000	0	0
Area E	2,699,000	0	2,609,000	$145,000
TOTALS	**8,867,000**	**1,221,000**	**7,646,000**	**$425,000**

Other Considerations

- Ease of Operation
- To Cap or not to Cap
- Capital Investment

DSWA's Future Goals

- Operate all active and closed cells as Bioreactors
- Eliminate offsite treatment of leachate
- Reach end of post closure period with a zero discharge leachate treatment system consisting of:
  - Recirculation system
  - Wetlands treatment system
  - Phyto cap